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ABSTRACT

A study identified what competencies secondary trade and industrial (T&I) instructors from Central Pennsylvania believed technology education should provide. A total of 33 instructors of 49 surveyed responded to a questionnaire developed from Pucel's (1992) categories of technology education and work attitudes as identified by Gregson (1991). An analysis of variance treatment indicated 27 competency comparisons significant at the $p=.05$ level. The results of the data analysis showed that the competencies T&I instructors would like technology education graduates to possess were not current high-tech issues. Rather, they identified these competencies: good work ethic, the ability to measure, and the ability to identify and use hand tools and equipment. Recommendations for technology education included emphasis on these affective domain attributes: following directions, pride in work, being dependable and punctual, exhibiting awareness of safety, and being conscientious. These cognitive and psychomotor competencies were recommended as core content of any technology education curriculum: measurement, identification and use of common hand tools and equipment, and knowledge of technical terminology. The following: competencies were not considered a major part of the technology education curricular content: economic factors, invention process, high-tech applications, and desktop publishing. (Contains 13 references.) (YLB)

WHAT ARE THE PREREQUISITES FOR TODAY'S T&I STUDENTS?

A Research Paper

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Nashville, Tennessee

by

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Abstract

During the last decade, the curricular content of technology education has evolved from industrial arts education. However, its relationship to trade and industrial (T&I) education, has not been identified. The purpose of this study was to identify what competencies T&I instructors believe technology education programs should be providing. T&I instructors from Central Pennsylvania were surveyed via a questionnaire developed from Pucel's (1992) categories of technology education and work attitudes as identified by Gregson (1991). An analysis of variance treatment indicated 27 competency comparisons significant at the $p = .05$ level. The data analysis indicated the competencies T&I instructors would like technology education graduates to possess are not the current high-tech items. Rather good work ethics, the ability to measure, plus the ability to identify and utilize hand tools and equipment were the competencies identified. Recommendations for technology education content are provided.

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Table

The curricular contents of both technology education and trade and industrial (T&I) education are in a state of flux. Technology education is evolving from industrial arts education to address the needs of a technological society, while T&I programs are attempting to identify their role in the Tech-Prep movement. Industrial arts education provided a definite articulation link from junior high school industrial arts education courses to secondary T&I programs. However, in today's technology education curriculum, this articulation link is unclear.

In an article entitled "Tech-Prep/Technology Education Relationship", Betts, Welsh, and Ryerson (1992) noted that technology education programs should provide students with the opportunity to gain knowledge, skills, ability, and confidence to pursue more indepth technical courses. In other words, the technology education field needs to become articulated with its follow-up programs in the same way that T&I and post-secondary technical education are establishing their Tech-Prep linkage. For this articulation to be successful, agreement on the curricular content of technology education must be established.

"Chaos and conflict certainly describe the current

status of technology curricula." (Rudisill, 1987, p. 7) This conflict has been very evident in determining the curriculum limits of the technology education. According to Lewis (1992), this conflict is one of the most challenging facets of the change from industrial arts education to technology education. Numerous presentations, papers, and documents, such as Technology education: A critical literacy requirement for all students (Pucel, 1992a), Technology education: Its changing role within general education (Pucel, 1992b), and A conceptual framework for technology education (Savage & Sterry, 1990), have attempted to delineate technology education content, however there still is not a consensus as to its curriculum. According to Schilleman (1987), the technology education field needs a well correlated, realistic, and logical curricular structure.

Pucel (1992a) noted that the lack of clear goals for technology education has led to the focus on the interaction between technology and society. With its focus on humanistic concerns and societal needs, technology education has forgotten to develop knowledge, skills, and attitudes needed related to the tools, equipment, materials, and processes of industry.

According to Nee (1993), students in technology education typically spend less time developing manipulative skills and dealing with industrial processes than their industrial arts predecessors. Nee further noted that in technology education "there is also a chance of neglecting development of craft skills" (p. 47).

In examining the goals of technology education, as developed by Savage and Sterry (1990), the affective and psychomotor domains of learning are absent. Only cognitive goals related to society and humanistic needs are indicated. These cognitive-only-centered goals are not advocated by Schilleman (1987). Schilleman indicated that middle school technology education programs should place greater emphasis on positive attitudes, work ethics, pride in workmanship, and a desire to continue into T&I programs.

Gregson (1991) noted that research on successful employment of secondary education graduates has indicated that affective competencies are as important, or more important than either cognitive knowledge or psychomotor skills. Carson, Huelskamp, and Woodall (1993) noted that 80% of employers express concerns about the work ethics and social skills of secondary

education students. The employers surveyed by Carson, Huelskamp, and Woodall were generally satisfied with the cognitive skills of secondary education graduates.

Gregson (1991) identified work values and attitudes that Virginia secondary T&I instructors perceived as being important to their programs. These affective domain competencies included; dependability, conscientiousness, cooperation, able to following directions, workmanship, and carefulness.

Pucel (1992a; 1992b) advanced ten categories that should comprise the technology education curricular content. Those categories were; 1) technical method, 2) common tool usage, 3) common equipment, 4) basic technological process, 5) materials, 6) terminology, 7) environmental concerns, 8) social values, 9) scientific principles, and 10) economic factors. The first six categories of content should be the primary focus of technology education programs, while the later four categories are recommended to be taught in other areas of the school curriculum. The first six categories address both the cognitive and psychomotor domains. However, a void exists with regard to students' attitudes. It was noted that it is not possible for technology education teachers to teach all of its

content (Pucel, 1992b). So what competencies should technology education instructors teach?

As outlined by Pucel (1992a), "instructors [must] first identify the ideas, tools, equipment, materials, and processes they wish to teach students." (p. 29) However, it should be the curriculum, generated by student needs and articulation agreements, that dictate what is taught in technology education. Articulation between technology education and further vocational education must be established. Without developing this linkage, what besides the teacher's definition of technological literacy is technology education preparing its graduates for?

Purpose

The purpose of this study was to ascertain what Central Pennsylvania secondary T&I educators perceive as the necessary knowledge, skills, and attitudes technology education graduates should possess. A secondary purpose of this study was to identify differences between the various secondary T&I programs with regard to technology education prerequisite knowledge, skills, and attitudes.

Research Questions

More specifically, the following research questions were addressed:

1. What knowledge, skills, and attitudes do Central Pennsylvania secondary T&I educators rate as the most and least important for technology education graduates to possess?

2. Is there a significant difference between the importance of different technology education cognitive, psychomotor, and affective competencies as rated by Central Pennsylvania secondary T&I educators?

3. What knowledge, skills, and attitudes do Central Pennsylvania secondary T&I educators from different vocational curriculum areas rate as the most and least important for technology education graduates to bring into their different T&I programs?

Methodology

Instrumentation

In order to address these research questions, a 27-item questionnaire was developed. Each item on the questionnaire was rated by the T&I instructors on a five-point Lykert-type scale (1 = useless to 5 = very important). The 27 items were derived from Pucel's

(1992a; 1992b) ten categories of technology education and Gregson's (1991) listing of important work values and attitudes as identified and rated by secondary T&I instructors. Additional questionnaire items were added to assess both traditional ideas and current trends in the technology education curricula. Traditional items included the ability to measure and the ability to utilize drafting. Questionnaire items related to current trends were derived from Hearlihy and Company's (1993) Modular Technology Education Program. These items included desktop publishing, knowledge of future technologies, and knowledge of computer applications.

Population and Sample

The population for this research consisted of the secondary T&I instructors from the Central Pennsylvania counties of Blair, Cambria, and Huntingdon. Each county operates an area vocational-technical school (AVTS). Blair County operates Altoona AVTS which has 27 T&I instructors. Cambria County utilizes Admiral Perry AVTS which employs 12 T&I teachers. Huntingdon County runs Huntingdon County AVTS which has 10 T&I instructors. Thus, the total population consisted of these 49 instructors. The response rates were: Altoona

AVTS 40.7% (n=11), Admiral Perry AVTS 100% (n=12), and Huntingdon County AVTS 100% (n=10). The overall response rate was 67.3% or a sample of 33 secondary T&I instructors. These T&I instructors were further divided by curriculum area (see Table 1).

Data Analysis

Analysis of the mean ratings for each of the 27 questionnaire items can be seen in Table 2. Three competencies tied for the top rating with a mean of 4.88 on the five-point Lykert-type scale. Those competencies (ability to follow directions, showing pride in workmanship, and being dependable/punctual) were all affective domain competencies. In examining the top rated seven items, six were affective domain attributes.

The lowest rated items, as perceived by the sample of T&I instructors, consisted of the modern technology education categories. The ability to perform desktop publishing (2.85) was ranked the lowest, followed by knowledge of high-tech applications (3.30), knowledge of economic factors (3.55), and knowledge about the invention process (3.55). It appears that the T&I instructors do not perceive modern technology education

Table 1

Sample of Central Pennsylvania T&I Instructors

T&I Area	Total Sample	Altoona AVTS	Huntingdon AVTS	Admiral Perry AVTS
Automotive Mechanics	6	2	2	2
Building Trades	4	1	1	2
Drafting	4	3	0	1
HVAC	4	1	2	1
Electrical	11	3	4	4
Machining/ Welding	4	1	1	2
Totals	33	11	10	12

Table 2

Descriptive Results For All Domains

Item Statement	M	SD
Ability to follow directions	4.88	.331
Showing pride in workmanship	4.88	.415
Being dependable/punctual	4.88	.415
Exhibiting a safety attitude	4.79	.485
Being conscientious/honest	4.79	.485
Ability to measure	4.70	.467
Cooperating with others	4.64	.653
Identification of common hand tools	4.49	.508
Utilize common hand tools	4.42	.751
Showing concern for the environment	4.39	.659
Identification of common equipment	4.30	.585
Operate common equipment	4.12	.857
Knowledge of technical terms	4.12	.893
Knowledge of basic processes	4.03	.847
Knowledge of computer applications	4.00	.829
Knowledge of future technologies	4.00	.901
Knowledge of basic materials	3.94	.747
Ability to perform basic processes	3.94	1.059
Knowledge of scientific principles	3.85	1.004
Utilize basic materials	3.79	.927
Interpretation of drafting drawings	3.79	.960
Apply scientific principles	3.70	1.045
Construct drafting drawings	3.67	1.137
Knowledge of economic factors	3.55	.794
Knowledge about the invention process	3.55	.833
Knowledge of high-tech applications	3.30	1.237
Ability to perform desktop publishing	2.85	1.064

items as being relevant to their T&I programs.

The highest rated cognitive knowledge was the ability to measure (4.70). The ability to measure was followed by identification of common hand tools (4.49) and identification of common equipment (4.30). The highest rated psychomotor skill was the ability to utilize common hand tools (4.42) with the ability to operate common equipment (4.12) next in rated importance.

Statistical analyses of the rated competencies from each of the three domains; cognitive, psychomotor, and affective, were conducted utilizing Tukey's (1977) test for the one-way analysis of variance (ANOVA) treatment. Ferguson (1981) recommended the ANOVA treatment be utilized to test the significance between means of numerous sets. Ferguson further noted that Tukey's method should be employed if the number of responses for each item were equal. Tukey termed this method the honestly significant difference method and noted its use in multiple comparisons. By utilizing Tukey's test, fewer significant differences than either the Newman-Keuls method or the Duncan method should be realized. It was felt that because of the small sample size ($n = 33$) a highly restrictive method of analysis

was appropriate. These ANOVAs can be seen in Tables 3, 4, and 5.

Statistically 16 comparisons of the 13 cognitive competencies proved to be significant at the $p = .05$ level ($Q > 4.470$). Technology education students' ability to measure was rated significantly higher by the T&I instructors than eight other cognitive items. Those items were; knowledge of high-tech applications ($Q = 9.441$), knowledge of the invention process ($Q = 8.655$), knowledge of economic factors ($Q = 8.655$), ability to interpret drafting drawings ($Q = 6.833$), knowledge of basic materials ($Q = 5.694$), knowledge of future technologies ($Q = 5.239$), knowledge of computer applications ($Q = 5.239$), and knowledge of basic processes ($Q = 5.011$).

Knowledge of technology education graduates to identify common tools tested significantly higher than three other competencies. Hand tool identification was significant when compared to; knowledge of high-tech applications ($Q = 7.939$), knowledge of economic factors ($Q = 7.061$), and the ability to interpret drafting drawings ($Q = 5.239$). The ability to identify common equipment tested significantly higher than; knowledge of high-tech applications ($Q = 6.652$), knowledge of the

Table 3

Cognitive Domain Results With ANOVA

Item Statement	M	SD
Ability to measure	4.70	.467
Identification of common hand tools	4.49	.508
Identification of common equipment	4.30	.585
Knowledge of technical terms	4.12	.893
Knowledge of basic processes	4.03	.847
Knowledge of computer applications	4.00	.829
Knowledge of future technologies	4.00	.901
Knowledge of basic materials	3.94	.747
Knowledge of scientific principles	3.85	1.004
Interpretation of drafting drawings	3.79	.960
Knowledge about the invention process	3.55	.833
Knowledge of economic factors	3.55	.794
Knowledge of high-tech applications	3.30	1.237

ANOVA

Source	df	Sum of Squares	Mean Square	F
Between subjects	12	58.97	4.914	6.962 *
Within subjects	416	293.64	0.706	
Total	428	352.61		

* $p < .001$

Table 4

Psychomotor Domain Results With ANOVA

Item Statement	M	SD
Utilize common hand tools	4.42	.751
Operate common equipment	4.12	.857
Ability to perform basic processes	3.94	1.059
Utilize basic materials	3.79	.927
Apply scientific principles	3.70	1.045
Construct drafting drawings	3.67	1.137
Ability to perform desktop publishing	2.85	1.064

ANOVA

Source	df	Sum of Squares	Mean Square	F
Between subjects	6	47.66	7.944	8.181 *
Within subjects	224	217.52	0.971	
Total	230	265.18		

* $p < .001$

Table 5

Affective Domain Results With ANOVA

Item Statement	M	SD
Ability to follow directions	4.88	.331
Showing pride in workmanship	4.88	.415
Being dependable/punctual	4.88	.415
Exhibiting a safety attitude	4.79	.485
Being conscientious/honest	4.79	.485
Cooperating with others	4.64	.653
Showing concern for the environment	4.39	.659

ANOVA

Source	df	Sum of Squares	Mean Square	F
Between subjects	6	6.35	1.058	4.150 *
Within subjects	224	57.09	0.255	
Total	230	63.44		

* $p < .001$

invention process (Q = 5.694), and knowledge of economic factors (Q = 5.694).

Knowledge of high-tech applications, as well as, being rated significantly lower than the ability to measure, the identification of hand tools, and identification of equipment, tested significantly lower than knowledge of technical terms (Q = 5.579) and knowledge of basic processes (Q = 4.721). These analyses of the cognitive competencies noted that the Central Pennsylvania secondary T&I instructors perceived traditional industrial knowledge as being of greater benefit to technology education students than high-tech applications.

Application of Tukey's ANOVA treatment to the psychomotor domain competencies indicated six significant comparisons at the p =. 05 level (Q > 4.170). Technology education students' ability to utilize common hand tools was rated significantly higher than their ability to utilize drafting to construct drawings (Q = 4.416), apply scientific principles (Q = 4.240), and perform desktop publishing (Q = 9.186). Students' ability to perform desktop publishing was also rated significantly lower than all five other psychomotor skills (Q = 4.770 to Q = 6.360).

In examining the application of the ANOVA treatment to the affective domain competencies, five of the seven competencies were rated significantly higher than showing concern for the environment ($p = .05$, $Q > 4.170$). Those five were: ability to follow directions, showing pride in workmanship, exhibiting a safety attitude, being conscientious/honest, and being dependable/punctual ($Q = 4.483$ to $Q = 5.517$). This finding confirms the initial indication of all the competencies mean rankings which noted those five affective domain skills as the top rated by the T&I instructors.

In comparing the six T&I curriculum area groupings, numerous similarities in the instructors' ratings of the cognitive and psychomotor competencies were noted. The instructors' ratings of the affective domain items were again rated consistently high with little disparity between subject areas. Because of the limited sample sizes of the six groups ($n = 4$ to $n = 11$), no statistical analyses were performed between the curriculum area groups.

All six subject area groups indicated a technology education graduate's ability to measure as the highest rated cognitive competency (5.00 to 4.50). Instructors

from all areas, except drafting, agreed on the next most important competency a technology education graduate could possess. That knowledge was the student's ability to identify common hand tools (5.00 to 4.50). In the psychomotor competencies, again all curriculum areas, except drafting, indicated one skill as their top priority. These T&I instructors indicated a student's ability to utilize common hand tools at the top of their list (4.75 to 4.25).

The T&I instructors from automotive mechanics, building trades, heating ventilation and air conditioning, electrical, and machining/welding areas also agreed on the technology education competencies of the least importance to their students. A student's knowledge oh high-tech applications, such as robots, lasers, or satellites, was rated as the lowest cognitive item by these five areas (3.91 to 2.25). In the psychomotor domain a student's ability to perform desktop publishing had the lowest ranking by instructors from these five areas (3.75 to 1.75).

Findings

The data collected and analyzed by this research indicated the following:

1. Central Pennsylvania secondary T&I instructors rated affective domain competencies developed in technology education programs as being the greatest benefit to their T&I programs.

2. The ability of technology education program graduates to measure, identify and use common hand tools, and identify and use common equipment rated significantly higher than knowledge of high-tech applications, such as robots, lasers, or satellites, by Central Pennsylvania secondary T&I instructors.

3. Disparity between the six different T&I curricular areas with regard to technology education knowledge, skills, and attitudes prerequisites was not indicated.

Discussion

The data clearly indicated that the knowledge, skills, and attitudes that Central Pennsylvania secondary T&I instructors would like technology education graduates to possess are not the current "trendy high-tech" items. Secondary T&I instructors

desire their students to possess good work ethics and attitudes, be able to measure, followed by the ability to identify and utilize common hand tools and equipment.

Recommendations

The findings of this research indicated the following recommendations for the fields of technology education and trade and industrial education.

1. T&I instructors and T&I leaders need to express their articulation concerns to technology education curriculum developers, both at national and local levels. Likewise, technology education curriculum developers and leaders need to communicate with their cohorts in the T&I arena to identify competencies that will articulate from technology education programs into further technical/industrial education programs.

This communication between the different segments of industrial education was initially suggested by Rudisill (1987). However, leadership in the technology education curricular change movement has failed to institute this vital communication link.

2. Technology education should stress the following affective domain attributes:

a. Following directions

b. Pride in workmanship

c. Being dependable and punctual

d. Exhibiting a safety attitude

e. Being conscientious and honest

3. The following cognitive and psychomotor competencies should be included as the core content of any technology education curriculum:

a. Measurement

b. Identification of common hand tools

c. Utilization of common hand tools

d. Identification of common equipment

e. Utilization of common equipment

f. Knowledge of technical terminology

4. The following competencies should not hold a major part of the technology education curricular content:

a. Economic factors

b. The invention process

c. High-tech applications

d. Desktop publishing

Conclusion

The field of industrial arts education/technology education has weathered some heavy storms and many crushing waves, but it is still afloat. However, to be a vital component of the modern educational establishment, the field must place its feet on firm ground. In order to accomplish this, technology education must establish a curricular content that is linked to its mother ship in the vocational education armada. Technology education must establish articulation with trade and industrial education. In the same lifesaving breath, trade and industrial education must communicate its prerequisites to the technology education field.

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